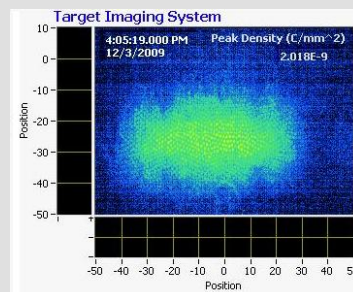


Oak Ridge National Laboratory Neutron Sciences Progress Report November 2009

Neutron Highlights

At HFIR, Cycle 424 ended November 6, 2009; Cycle 425 began November 25, 2009, and end December 21, 2009.

At SNS, neutron production resumed September 10, 2009, and will end December 22, 2009. The target and proton beam window were replaced and the optics portion of a new imaging system of the proton beam on target was added, see the image to the right.



Science Highlights

Research conducted at HFIR's Neutron Residual Stress Mapping Facility and at Los Alamos National Laboratory **analyzed residual stress** generated in a 6061-T6 aluminum alloy plate by thermomechanical deformation from friction stir welding. The evolution of residual stress during natural aging up to 10,000 hours was investigated by neutron diffraction. A data reduction method was developed to eliminate microstructural influences on lattice spacing changes, allowing the long-range macroscopic residual stresses to be determined. Results showed that the residual stress decreased by approximately 25 MPa over time as a result of microstructural modification within the deformed region during natural aging. W. Woo, Z. Feng X.-L. Wang, and C. R. Hubbard, Neutron diffraction measurements of time-dependent residual stresses generated by severe thermomechanical deformation, *Scripta Materialia* **61**(6), 624–627 (2009). [doi:10.1016/j.scriptamat.2009.05.040](https://doi.org/10.1016/j.scriptamat.2009.05.040).



A Workshop on Neutron Spin Echo Spectroscopy was held November 4–5, 2009, at SNS. Research highlights on biophysics, complex fluids, polymer dynamics, and new directions and trends were presented to 80 attendees. The beam line was [inaugurated](#) with the visits of Steven Koonin (U.S. Department of Energy) and Beatrix Vierkorn-Rudolph (German Ministry of Education and Research). Photos and pdfs of selected talks are [available](#).

Three-dimensional phonon dispersions were recently mapped in a single crystal of FeSi (B20 cubic, 8 grams), using the **ARCS** time-of-flight spectrometer at the SNS. The measurements used a reciprocal-space tomography approach, which involved collecting scattered neutrons in the large detector bank of ARCS, for 45 different orientations of the crystal (in 1-degree rotation steps), allowing researchers to fully sample the four-dimensional (h,k,l,E) space. Results were in agreement with partial data collected on the HB-3 Triple-Axis Spectrometer at HFIR. Temperature-dependent measurements showed that phonons in FeSi are strongly affected by the metal-insulator transition in this compound. These results have been rationalized using ab-initio molecular

dynamics simulations. The research team is O. Delaire, M.S. Lucas, M.B. Stone, D.L. Abernathy, K. Marty, P.R. Kent, B.C. Sales, and D. Mandrus, all of ORNL, and the results are to be published.

Supramolecular assembly of artificial photoconversion units was studied at the HFIR Bio-SANS instrument. Plants have evolved sophisticated methods for converting sunlight to energy. The goal of this research is to use Light Harvesting Complex II (LHC II), a photosynthetic membrane protein, to understand the interaction of natural photosynthetic systems with synthetic block copolymers. In addition to demonstrating that natively-structured LHC II can be purified from the native membrane with detergent, the work demonstrates that purified LHC II modulates the structure of the block copolymers, in a manner similar to its role in the native membrane. Further, LHC II- block copolymer hybrid systems are capable of converting solar energy to hydrogen, a clean renewable fuel. The interdisciplinary team of Hugh O'Neil, Kunlun Hong, William Heller, Xiang Yu, Mateus Cardoso, and Dmitriy Smolensky are from ORNL's Chemical Sciences Division, Center for Nanophase Materials Sciences, and Center for Structural Molecular Biology.

Instruments and Users

User Statistics FY 2009

HFIR:	Unique users: 358
	Total users: 888
	Proposals: 137
	Experiments: 198
	Subscription rate: 2.05
SNS:	Unique users: 307
	Total users: 469
	Proposals: 156
	Experiments: 106
	Subscription rate: 2.48

Subscription rate is days requested divided by days available.

FY 2009 User Performance Statistics

are available. Compiled by the User Office, [these](#) include number of users, their home institutions, proposals submitted and user days requested by beam line, trending data for proposals and days requested, instrument subscription rates and trends, survey satisfaction results, and trending data.

Publication citations needed. We need citations to publications based on research at SNS and HFIR; please complete the [form](#) or send the citation to neutronusers@ornl.gov. There is an appropriate [acknowledgment](#) for experiments at HFIR and SNS.

Infrastructure improvements are coming. Construction completion of the Joint Institute for Neutron Sciences is scheduled for June 2010. The cafeteria in the SNS Central Lab and Office building will begin operating in January 2010. The ORNL Guest House construction is slated

to begin December 2009 adjacent to JINS at SNS.

Travel grants are available through The University of Tennessee for faculty and students from institutions in [EPSCoR states](#) to carry out approved experiments at HFIR or SNS and for travels to discuss experiments before and after the measurements. Contact [Hope Moore-Webb](#) for details.

Science laboratories are operational at HFIR. The second floor science labs in the SNS Central Laboratory and Office building are scheduled for completion in May 2010. The target building materials handling lab is expected to open April 2010. The mercury and post-beam sample handling labs are scheduled to be ready in November 2010.



VULCAN commissioning has begun. Initial testing of load frame integration on the VULCAN engineering diffractometer at SNS (shown above) is currently under way.

Middle Tennessee State University, North Carolina State University and Hauptman-Woodward Medical Research Institute have [received](#) funding for a **single-crystal neutron diffractometer**, called IMAGINE, through the National Science Foundation and the American Recovery and Reinvestment Act. MTSU principal investigator Tibor S. Koritsanszky and colleague Flora Meilleur from North Carolina State, in collaboration with Robert Blessing from HWMRI and ORNL's Bryan Chakoumakos, will use IMAGINE to analyze light atom positions in materials of interest across the diverse fields of chemistry, structural biology, pharmacology, condensed-matter physics, and nanostructured materials and in the environmental, biomedical, and geological sciences. The instrument will be located at HFIR.



NOMAD detector tank arrives. The detector tank (shown above) for the Nanoscale-Ordered Materials Diffractometer (SNS, BL 1B) is undergoing on-site leak-checking. Then

the detector brackets will be mounted and the process of pulling cables will begin for detectors inside the tank. The tank will then be moved to the beam line. After the tank enclosure is finished, the detectors will be mounted inside the tank.



Stronger magnetic fields are on the way to SNS. A major milestone was met on the 16 Tesla actively shielded magnet developed through collaboration with Paul Scherrer Institut. The magnet (shown above) passed factory acceptance tests in October, and is expected to be commissioned at SNS in 2010. Through a magnet collaboration with Tohoku University, Sendai, Japan, 30-Tesla

pulsed magnetic fields are becoming available at the SNS and HFIR. Initial feasibility measurements were recently conducted on the SNS SEQUOIA beamline.

The **Fundamental Neutron Physics** external building (SNS, BL13) is complete. It will house a facility to study ultracold neutrons as part of the neutron electric dipole moment experiment, which will begin installation in 2010. In the meantime, installation of the first experiment (to study the npdgamma interaction) inside the target building is in progress. First beam delivery is expected in mid 2010.

A **Sample Environment Steering Committee** is hard at work to provide guidance to ORNL. The committee includes [Stephen Wilson](#) and [Ursula Perez-Salas](#) from the SNS-HFIR User Group, and is presently reviewing and prioritizing equipment development proposals.

Four new instrument development beamlines are nearly completed at the

CG-1 end-guide position off the HB4 cold source at the HFIR. CG-1A will initially be used for developing the **SERGIS** (Spin-Echo Scattering Angle Measurement) technique and will begin commissioning in November 2009. CG-1B is a **utility diffractometer** that will be used for characterizing crystals, monochromator and analyzer assemblies, and other optical components as well as for orienting samples for user experiments on other instrument in the user program. This beam will be available in January 2010. CG-1C is a **multipurpose monochromatic beam** that will be used for neutron imaging development, instrument prototyping, and development of focusing optics and will be available in the spring of 2010. CG-1D is currently operating and is a general purpose time-of-flight beam and will be used for prototyping of instruments such as **MISANS**, low-energy cross-section measurements, as well as development of optical components such as focusing optics and ^3He polarization cells.

Operations

HFIR

At HFIR, Cycle 424 began October 14, 2009, and ended November 6, 2009. There was a 2-day shutdown beginning October 31, 2009. Irradiations were performed for Naval Research Labs, fusion research and the US/Japan Fusion Energy Collaborative Program, commercial and medical isotopes, and medical isotope R&D. Selected HFIR goals for FY 2010:

- Operate for 6 cycles in FY 2010 with predictability >90%
- Complete US-Japan Triple Axis (HFIR, CG-4C) and have nine instruments in the User Program
- Deliver development beam lines at HFIR
- Begin construction of IMAGINE diffractometer



HFIR Family Day tours on September 26, 2009.

SNS

The SNS began accelerator startup on August 31, 2009. Neutron production began on September 10, 2009, and will continue until December 22, 2009. The SNS achieved 1 MW of beam power on target on September 18, 2009. The first target and proton beam window replacements were successfully completed without disrupting neutron production for users. The target received nearly twice the cumulative beam that was expected to be its lifetime limit. The new proton beam window incorporates the optics portion of a new target imaging system. Selected SNS goals for FY 2010:

- Deliver 3900 neutron production hours, 4800 total operating hours, with beam power reaching 1.2 MW
- Complete NOMAD instrument (SNS, BL1B) and have 13 instruments in the User Program
- Complete accelerator improvement projects to achieve a reliability goal of 85%
- Finalize criteria for pulse length and target for Second Target Station

Employment Opportunities

Positions in the Neutron Sciences Directorate or related to neutron scattering. Click on “View Open Positions” at <http://jobs.ornl.gov/> and view Position Category noted as “Science—Neutron Science.”

- Clifford G. Shull Fellowship Program (applications will be accepted until December 13, 2009)
- Instrument Development Scientist (NC50171745)
- Collaborative Research Visits Program, including Visiting Student Thesis Research, Visiting Postdoctoral Research, and Faculty Research Sabbaticals; see <http://neutrons.ornl.gov/crv/>.

Neutron Sciences Career Development Program <http://www.ornl.gov/orise/edu/ornl/neutrons/>. The Neutron Sciences Career Development Program was founded to nurture the creative development of neutron scattering science and instrumentation at ORNL. This initiative is viewed as a critical part of keeping the neutron scattering instruments at ORNL on the cutting edge of design and scientific functionality, keeping them competitive worldwide. It is designed to provide an environment in which early-career scientists and technicians can be a part of innovative concepts for neutron-related research and instrumentation while helping end users develop proposals, conduct experiments, and analyze data. See opportunities for Neutron Scattering Instrument Scientist, Neutron Scattering Instrument Associate, and Neutron Scattering Technician.

Fellowship Positions with ORNL through Oak Ridge Associated Universities. Descriptions are available at <http://www.ornl.gov/orise/edu/ornl/postneeds.htm>. Recently announced open positions are

- [Postdoctoral Research Associate in Neutron Scattering](#): thermoelectric materials (ORNL10-21-NSSD)
- [Postdoctoral Research Associate for Developing the Spin-Echo Grazing Incidence Scattering \(SERGIS\)](#) (ORNL10-17-NFDD)
- [Postdoctoral Research Associate in Neutron Scattering](#): organic superconductors (ORNL10-16-NSSD)
- [Postdoctoral Research Associate in In-situ Neutron Scattering Studies of Fuel Cell Materials](#) (ORNL10-06-NSSD)
- [Postdoctoral Research Associates in SANS and Neutron Reflectometry Data Reduction and Analysis](#) (ORNL10-02-NSSD)
- [Neutron Scattering Instrument Scientist, Engineering Diffraction](#) (ORNL09-132-NSSD)
- [Postdoctoral Research Associate Position: Neutron Scattering](#) (FIRST-04-ORNL)
- [Mechanical Engineering/Experimentalist—Post-Masters](#) (ORNL09-99-NFDD)
- [Neutron Scattering Instrument Scientist](#) (ORNL09-98-NSSD)
- [Scientific Computing Researcher](#) (ORNL09-94-NSSD)
- [Scientific Computing Associate](#) (ORNL09-93-NSSD)
- [Postdoctoral Research Associate in Instrument Development](#) (ORNL09-89-NFDD)
- [Postdoctoral Research Associate in Neutron Scattering Studies of Fluids & Polymers Under Confinement](#) (ORNL09-88-NSSD)

Educational and Research Experiences

ORNL has educational programs covering many scientific disciplines with the education continuum from pre-college through postgraduate, including teachers and faculty. The main link to all of these programs is <http://www.ornl.gov/orise/edu/ornl/>. Applications are open now.

Meetings of Interest to SNS and HFIR Users

January 21–22, 2010, [VULCAN \(SNS\) Instrument Development Team Meeting](#), Oak Ridge, Tennessee, USA.

February 10–13, 2010, [National Society of Black Physicists](#), Washington, D.C. ORNL booth.

March 15–19, 2010, [American Physical Society Meeting](#), Portland, Oregon, USA. ORNL booth.

March 19–20, 2010, [Southeast Regional Collaborative Access Team \(SER-CAT\) Symposium and Board Meeting](#), Oak Ridge, Tennessee, USA.

April 5–9, 2010, [Materials Research Society \(MRS\) Spring Meeting](#), San Francisco, California, USA. ORNL booth. **Note Session W: Diagnostics and Characterization of Energy Materials with Synchrotron and Neutron Radiation.**

April 20–21, 2010, Hydrogen and Helium Isotopes in Materials Conference, Oak Ridge, Tennessee, USA.

June 12–26, 2010, National School on Neutron and X-Ray Scattering, Argonne and Oak Ridge. Registration to open soon.

June 13–18, 2010. [20th Annual VM Goldschmidt Conference](#), Knoxville, Tennessee, USA. This is the foremost meeting of the year for the worldwide geochemistry community.

June 26–30, 2010. [American Conference on Neutron Scattering](#), Ottawa, Ontario, Canada.

Proposal Call Dates for HFIR and SNS

March 3, 2010, midnight, Wednesday: proposals for the period June–November 2010

September 1, 2010, midnight, Wednesday: proposals for the period December 2010–May 2011

March 2, 2011, midnight, Wednesday: proposals for the period June–November 2011

September 14, 2011, midnight, Wednesday: proposals for the period December 2011–May 2012

Neutron Science in the News



The [ORNL Review](#) issue **Volume 42, Number 3, 2009** is focused on the Spallation Neutron Source (SNS).

The [report](#) **Frontiers in Crystalline Matter: From Discovery to Technology**, prepared by the Committee for an Assessment of and Outlook for New Materials Synthesis and Crystal Growth, National Research Council, notes (page 89) “the Spallation Neutron Source at the Oak Ridge National Laboratory and improved moderators and neutron optics at existing reactor facilities are leading to several orders-of-magnitude improvement in sensitivity and capacity. As a result, a substantial expansion in the use and impact of the neutron-scattering technique in research is occurring, which parallels the transition from rotating anodes to synchrotron sources for x-rays.” The report also says (page 92) “the Department of Energy has created extraordinary conditions for synergy between crystalline matter discovery and characterization for nanostructured materials. An example is the Center for Nanophase Materials Science collocated with the Spallation Neutron Source. Combining deuterium-labeled polymer synthesis capabilities with small-angle neutron scattering and neutron reflectometry provides unprecedented capabilities for creating and probing self-assembled nanoscale structures for fundamental science and applications.”

Recent articles about the Oak Ridge neutron scattering program and summaries of the International Conference on Neutron Scattering have appeared in [Notiziario Neutroni e Luce di Sincrotrone](#) (v.14(2), September 2009), and [Neutron News](#) (v.20(4)).

[Energy push spurs shift in US science](#) (Wall Street Journal, 11/25). By Gautam Naik. OAK RIDGE, Tenn. — The Obama administration's push to solve the nation's energy problems, a massive federal program that rivals the Manhattan Project, is spurring a once-in-a-generation shift in U.S. science. The government's multibillion-dollar push into energy research is reinvigorating 17 giant U.S.-funded research facilities, from the Oak Ridge National Laboratory here to the Lawrence Berkeley National Laboratory.

[13 ORNL reactors reveal history \(Knoxville News Sentinel 11/2\)](#). The history of Oak Ridge National Laboratory, to a large extent, can be told through its nuclear reactors, and it's quite an eventful story. The reactors have received visits from Kennedys and royalty. They've saved lives by producing cancer-killing isotopes. They've been a training ground for generations of nuclear engineers and a proving ground for Nobel Laureates.

[Physics student's project will impact international research at Oak Ridge lab \(10/27\)](#). An Ohio County student's summer internship project will begin paying dividends this week for the international scientific community at the Oak Ridge National Laboratory. Nathan Campbell, a WKU junior from Beaver Dam, assisted in programming the PAGES (Portable Automated Gas

Environment System) device this summer as a Higher Education Research Experiences intern for the Sample Environment Group at the Spallation Neutron Source at ORNL.

Former ORNL researcher wins Nobel Prize (ORNL Press Release 10/7). One of the winners of the 2009 Nobel Prize in Chemistry spent the early part of his career at Oak Ridge National Laboratory. Venkatraman Ramakrishnan, or "Venki" as he was known to his colleagues, was a researcher at ORNL's High Flux Isotope Reactor in the early 1980s.

ORNL pulsed Spallation Neutron Source breaks one megawatt barrier for the first time (R&D Magazine 9/29). "Advances in the materials sciences are fundamental to the development of clean and sustainable energy technologies. In reaching this milestone of operating power, the Spallation Neutron Source is providing scientists with an unmatched resource for unlocking the secrets of materials at the molecular level," said Dr. William F. Brinkman, Director of DOE's Office of Science.

Researchers compare neutron 'microscope' upgrade to laser vs. flashlight (Knoxville News Sentinel 9/7). The Spallation Neutron Source at Oak Ridge returned to action with a bang this weekend following a long summer maintenance period. Among the highlights was installation of a new Target Imaging System that's designed to get a picture of the proton beam smashing the target in pulses 60 times each second. The new camera is reportedly much sturdier than an earlier version and tough enough to survive the environment as power load begins to approach the SNS design capability of 1.4 megawatts and beyond. According to internal correspondence, ORNL's Curt Maxey said the system "worked as planned from the very first pulse."

The most up-to-date news articles featuring neutron science performed at ORNL are available at http://neutrons.ornl.gov/news/current_news.shtml. You can sign up for an RSS feed [here](#) for ORNL Neutron Sciences. To receive ORNL news via twitter, use <http://twitter.com/oakridgelabnews>.